

Pneumothorax Treated by Small-Bore Chest Tube

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Pneumothorax is the most common significant complication associated with percutaneous chest biopsy. It is mandatory for any physician performing a lung biopsy to be adept at treating this complication.

CASE REPORT

A 68-year-old man with an 80-pack history of smoking was noted to have a new mass on chest computed tomography (CT) (Fig. 1). He underwent CT-guided percutaneous chest biopsy. After informed consent was obtained, he was placed prone on the CT gantry and the mass was localized using a grid placed on the skin (Fig. 2A). After administration of local anesthesia, an 18-gauge trocar needle was advanced to the mass. Core biopsies and fine-needle aspiration was performed through this trocar using 21-gauge biopsy devices and needles (Fig. 2B).

Upon removal of the needle, a small pneumothorax was apparent on final chest CT images (Fig. 2C). The patient was otherwise asymptomatic and was sent for upright chest radiographs in inspiration and exhalation that revealed a large apical pneumothorax (Fig. 3). The patient was brought to the interventional radiology (IR) suite and placed on the fluoroscopy table in a supine position. After cleansing the skin of the upper anterior chest with a chlorhexidine solution, the interspace between the second and third anterior ribs was localized in the midclavicular line and anesthetized with lidocaine. A small skin nick was made with a no. 11 scalpel blade and a 6.3F pigtail catheter (Turner pigtail pneumothorax kit; Cook, Indianapolis, IN) was inserted using a trocar technique. Specifically, the tube was placed over a rigid metal trocar and the unit was advanced into the chest.

When a decrease in resistance was felt, the tube was advanced off the trocar to the apex of the lung using fluoroscopic guidance. The metal trocar was then removed and the pneumothorax was evacuated using a 50-mL syringe attached to the tube with a three-way stopcock (Fig. 4). A Heimlich Valve (BD Medical, Franklin Lakes, NJ) was then attached to the tube and the patient was sent for upright inspiration and exhalation radiographs that demonstrated reaccumulation of the pneumothorax (Fig. 5).

The patient returned to the IR recovery area and the pneumothorax was reevacuated and the tube repositioned slightly more apically. The tube was then attached to a water seal chest drainage system (Pleurovac Ocean Water Seal Chest Drain; Atrium Medical, Hudson, NH). The patient was admitted and placed on low wall suction (10 cm water). The pneumothorax did not recur overnight and the tube was clamped the following morning. Follow-up chest radiographs revealed no recurrence (Fig. 6) and the tube was removed. A final chest radiograph 2 hours after tube removal showed the lung remained well aerated (Fig. 7).

DISCUSSION

Iatrogenic pneumothorax is reported to occur in between 5 and 20% of patients after percutaneous lung biopsy. Factors that increase the risk of pneumothorax include emphysema, small lesions, deep lesions, and ventilatory obstruction. The number of passes through the pleura rather than needle size appears to increase risk. Therefore, many practitioners use a coaxial technique with a larger outer needle and smaller inner needles to perform this procedure. If a pneumothorax is identified during

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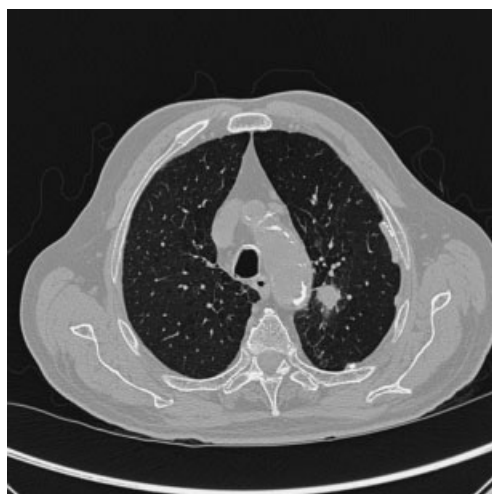


Figure 1 Chest computed tomography (CT). Chest CT shows speculated left upper lobe lung mass.

the biopsy, it may be aspirated by the outer coaxial needle prior to its removal from the chest cavity. Often this maneuver will obviate the need for chest tube placement. Small asymptomatic pneumothoraces (< 20%) may be observed. Indications for chest tube insertion include pneumothorax with dyspnea or decreasing oxygen saturation below 95%, > 30% pneumothorax, and tension pneumothorax.

Chest tubes can be inserted anteriorly or laterally. I generally prefer an anterior approach with the tube in the interspace between the first and second rib in the midclavicular line (Fig. 8). On occasion, in patients with coexisting pleural disease, tube insertion needs to be targeted to a loculated pneumothorax. This can be done with either CT or fluoroscopic guidance. Either the trocar or Seldinger technique (Fig. 9) may be used. I generally prefer a trocar technique simply because it is slightly faster than the Seldinger technique, but most of my fellows and residents are taught to

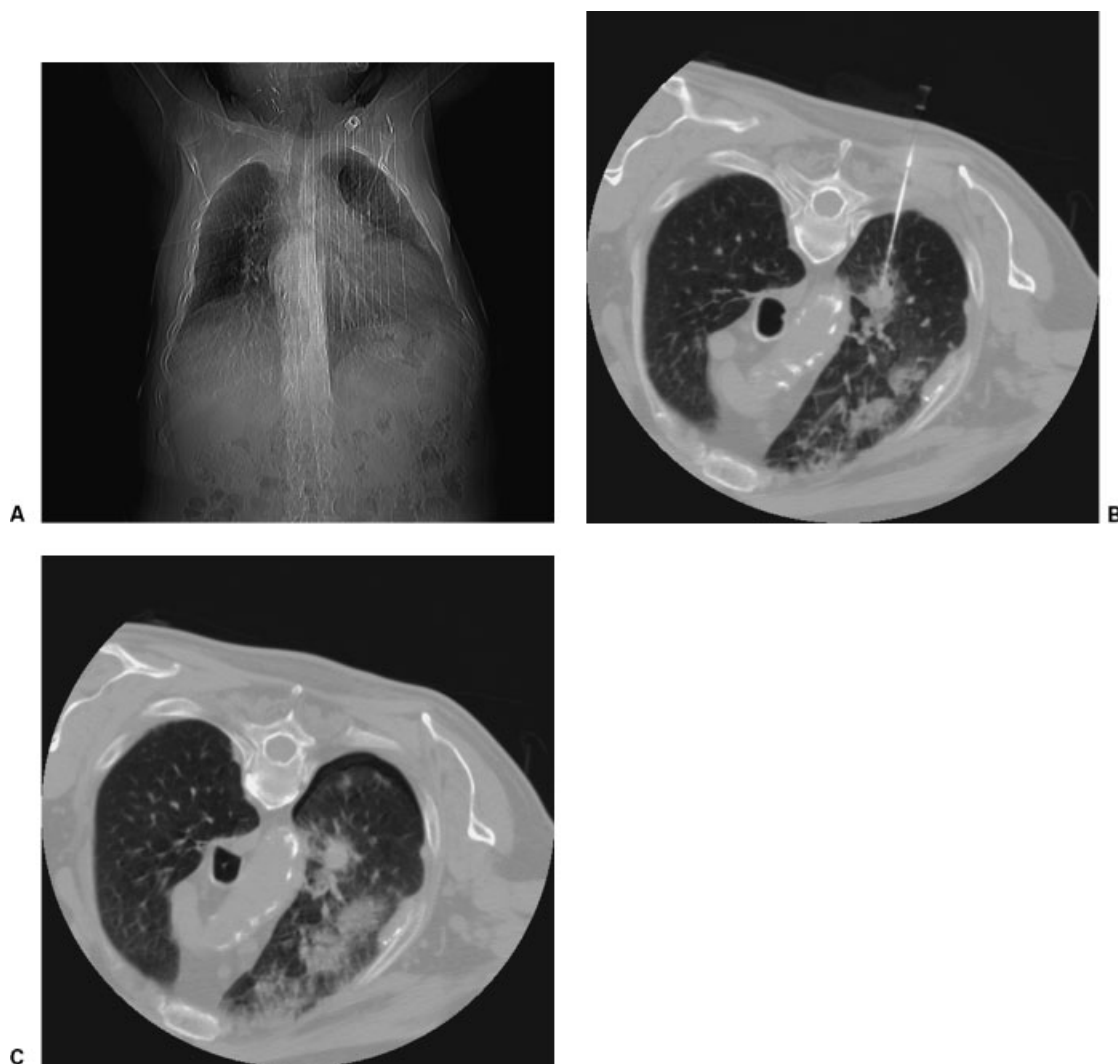


Figure 2 Lung biopsy. (A) Initial scout view shows skin localizing grid over left lung apex. (B) Computed tomography (CT) image shows 18-gauge trocar needle in mass. (C) CT image after needle removal demonstrates small pneumothorax.



Figure 3 Postbiopsy upright chest radiograph. Postbiopsy chest radiograph shows large left apical pneumothorax.

use the Seldinger technique initially because this latter technique is more “forgiving.” In general, the tube should be positioned so the pigtail is located at the apex of the lung—occasionally, the tube migrates more inferiorly and needs to be repositioned to facilitate drainage. I use the Turner pneumothorax kit (Fig. 8). Rarely, a larger drainage catheter is required (8 to 10F) to effect adequate treatment.

After tube insertion, the pneumothorax is evacuated using a large syringe (e.g., 50 mL), and a Heimlich or flutter valve is attached. It is imperative to attach the valve in the correct orientation. This is clearly labeled on the valve itself and should be intuitive on inspection of the device. If it is attached

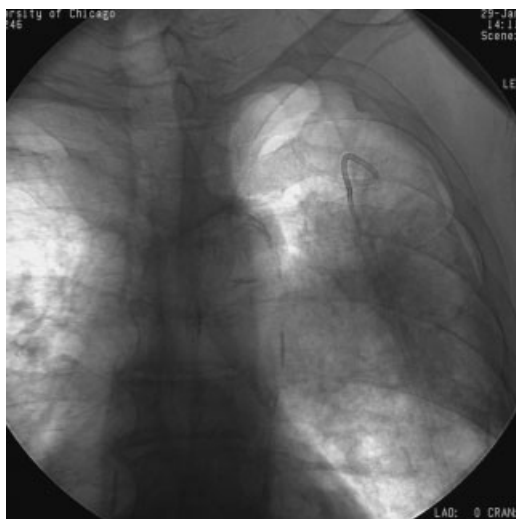


Figure 4 Chest tube insertion. Fluoroscopic image shows pigtail catheter evacuating left apical pneumothorax.



Figure 5 Chest radiograph after chest tube placement. Chest radiograph shows persistent left apical pneumothorax.

backward, a tension pneumothorax could result (i.e., air is let into the pleural space but not out via the tube). In most cases, a Heimlich valve prevents an iatrogenic pneumothorax from recurring. Typically, in my practice, the valve is left in place for 2 hours with repeat chest radiographs after this period of time. It is important to assess pneumothoraces with chest radiographs rather than supine fluoroscopic images because the latter usually underestimate the size



Figure 6 Chest radiograph after overnight suction. Chest radiograph shows reexpansion of the lung with no evidence of a residual pneumothorax.



Figure 7 Chest radiograph after chest tube removal. Chest radiograph demonstrates no residual pneumothorax.

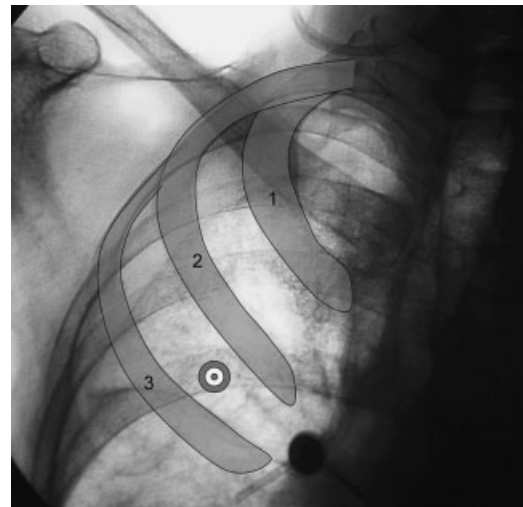


Figure 8 Image depicts chest tube insertion site.

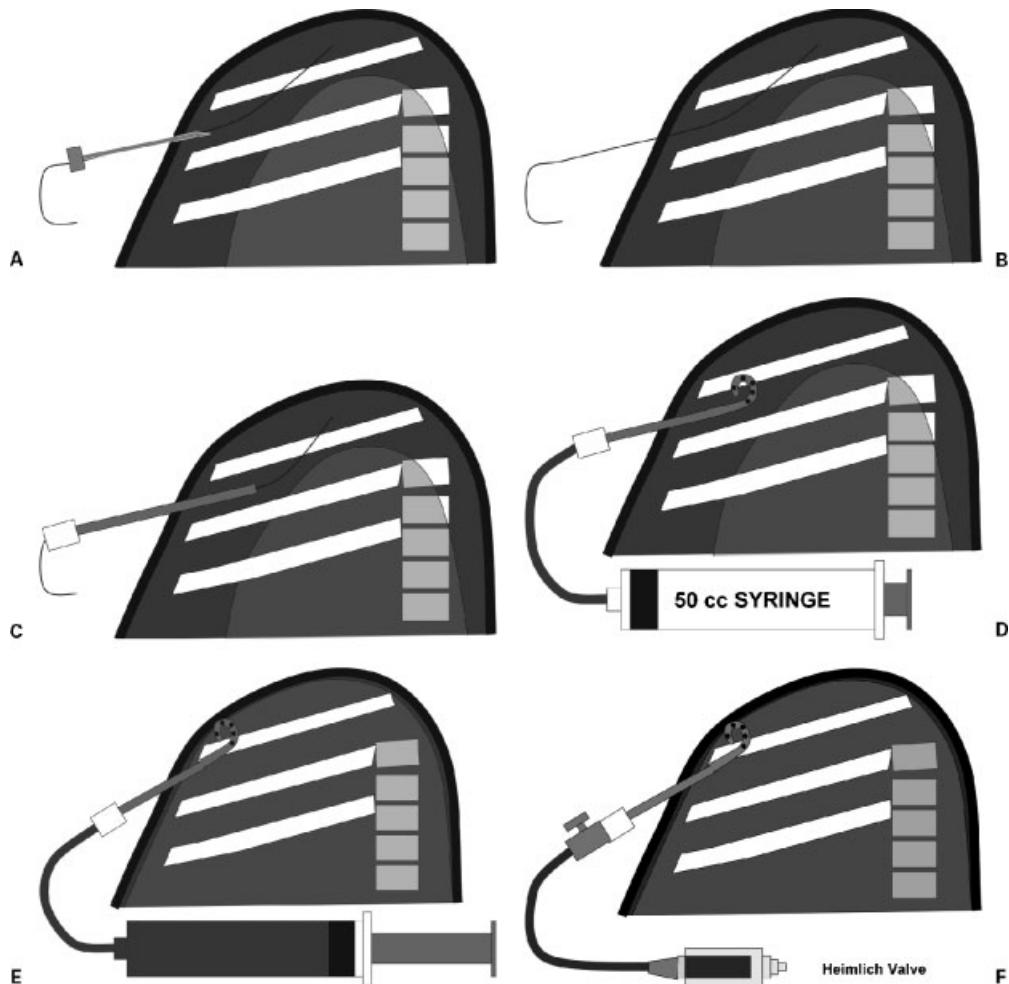


Figure 9 Chest tube insertion using Seldinger technique. (A) Puncture is made using a needle and guidewire is inserted into pleural space. (B) Needle is removed leaving guidewire in place. (C) Tube is inserted after serial dilation. (D) Guidewire is removed and tube is attached to 50-mL syringe. (E) Pneumothorax is evacuated. (F) Tube is attached to Heimlich Valve (BD Medical, Franklin Lakes, NJ).

of a pneumothorax. If the pneumothorax has not recurred, the valve is closed and chest radiographs are repeated at 2 hours. If the pneumothorax has not recurred, the tube is removed and final chest radiographs are obtained 2 hours after tube removal. If the pneumothorax has not recurred, the patient is sent home. The time course of this algorithm also mandates that biopsies be performed in the morning so that even when pneumothoraces requiring drainage occur, many patients can be sent home the same day. If the pneumothorax recurs with a Heimlich Valve in place, the tube is attached to a Pleurovac system, which is then attached to wall suction.

The Pleurovac device used in my hospital is a three-chambered device that can be used as either a one-way valve or attached to wall suction. The first chamber collects any fluid from the pleural space. The second chamber contains the water seal that acts as a one-way valve. It is identical in concept to a P-valve on the bottom of a household sink. If bubbling is seen in this

chamber, it indicates that air is being removed from the pleural space. A graduated scale on this chamber helps determine if the air leak is improving, worsening, or remaining the same. The third chamber also contains water and a “straw” that regulates the degree of suction applied to the tube. Empirically, a pressure of 20 cm of water is most commonly used. Wall suction should be adjusted so gentle bubbling is present in this third chamber. Increasing the wall suction will *not* increase the suction on the tube—this is regulated by the level of the “straw” on the Pleurovac. The Pleurovac should always be placed below the level of the chest tube. Once attached, it is generally easier on the patient to repeat chest radiographs portably.

SUGGESTED READING

Lorenz J, Blum M. Complications of percutaneous chest biopsy. *Semin Intervent Radiol* 2006;23:188–193